PATENT SPECIFICATION (11) 1 480 736

1 480 736

(21) Application No. 39991/73 (22) Filed 23 Aug. 1973
(23) Complete Specification filed 8 Aug. 1974
(44) Complete Specification published 20 July 1977
(51) INT CL² H02H 3/20
(52) Index at acceptance
H2K 254 452 580 600 650

(72) Inventor JOHN HAROLD BLACKETT

(19)

(54) ELECTRODIATHERMY APPARATUS

(71) We, MATBURN (HOLDINGS) LIMITED, a British company of Three Colts Lane, Bethnal Green, London E.2., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electrodiathermy apparatus.

Such apparatus has associated with it an electric shock hazard. This is of particular concern with an electrodiathermy generator where electrodes are connected directly to a patient.

With a conventional electrodiathermy generator, a plate electrode is connected to earth and, therefore, connects the body of the patient directly to earth. One of the most common causes of electric shock is the passage of an electric current from a "live" source in contact with the patient to earth via the plate electrode. The "live" source may be an electrode from another piece of equipment which has become live due to a fault within the equipment.

This electric shock hazard may be prevented by isolating an output circuit of the electrodiathermy generator from earth to provide a very high impedance to earth to the passage of current at the power supply frequency. However, this form of [illegible] produces a [illegible] that passes a small current through the plate electrode circuit, with a relay or similar means to detect the passage of this current if the circuit is complete. The relay can be arranged to operate an alarm if there is a loss of continuity in the plate circuit. This system has certain disadvantages, namely: (a) a twin conductor plate electrode lead is required, (b) the monitoring current can produce an electric shock hazard, (c) the monitoring current can cause interference with patient monitoring apparatus, and (d) the monitor circuit requires additional circuit components connected to the plate electrode circuit increasing the difficulty of maintaining satisfactory electrical isolation.

An object of the present invention is to provide a way of making an electrodiathermy generator with an isolated output circuit, but without the hazard of diathermy burns from the plate circuit.

A further object of the invention is to eliminate the need for a plate electrode lead continuity monitor by providing an arrangement in which if the plate electrode is not connected or the lead is broken and an attempt is made to use the apparatus, the output voltage on the plate circuit will raise above the trigger level of the monitor, causing the generator to be switched off. To prevent the voltage exceeding the trigger level the plate must be connected to [illegible] capacitive impedance to

PATENTS ACT, 1949

SPECIFICATION NO 1480736

The following amendments were allowed under Section 29 on 21 September 1979:

Page 2, line 117, *delete* of first occurrence *insert* being connected to the voltage sensitive circuit which raises

Page 2, line 118, *delete* being rapidly changeable *insert* to change rapidly

THE PATENT OFFICE
2 November 1979

Bas 72062/4

1 480 736

PATENT SPECIFICATION

(11) 1 480 736

(21) Application No. 39991/73 (22) Filed 23 Aug. 1973
(23) Complete Specification filed 8 Aug. 1974
(44) Complete Specification published 20 July 1977
(51) INT CL² H02H 3/20
(52) Index at acceptance
H2K 254 452 580 600 650
(72) Inventor JOHN HAROLD BLACKETT

(19)

(54) ELECTRODIATHERMY APPARATUS

(71) We, MATBURN (HOLDINGS) LIMITED, a British company of Three Colts Lane, Bethnal Green, London E.2., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electrodiathermy apparatus.

Such apparatus has associated with it an electric shock hazard. This is of particular concern with an electrodiathermy generator where electrodes are connected directly to a patient.

With a conventional electrodiathermy generator, a plate electrode is connected to earth and, therefore, connects the body of the patient directly to earth. One of the most common causes of electric shock is the passage of an electric current from a "live" source in contact with the patient to earth via the plate electrode. The "live" source may be an electrode from another piece of equipment which has become live due to a fault within the equipment.

This electric shock hazard may be prevented by isolating an output circuit of the electrodiathermy generator from earth to provide a very high impedance to earth to the passage of current at the power supply frequency. However, this form of isolated output circuit itself produces a hazard in that the output of the generator can appear between the plate circuit and earth. This could cause burns to the patient or to any person in contact with the plate circuit when the generator is energised. The condition will occur if a low impedance path exists between the active output terminal and earth, for example if the active electrode is placed upon earthed metal.

It is well known that for safety use of an electrodiathermy apparatus it is essential to ensure that the plate electrode is connected to the generator and that there is continuity throughout the connecting lead. Hitherto, it has been normal practice to include in an electrosurgical generator a monitor circuit that passes a small current through the plate electrode circuit, with a relay or similar means to detect the passage of this current if the circuit is complete. The relay can be arranged to operate an alarm if there is a loss of continuity in the plate circuit. This system has certain disadvantages, namely: (a) a twin conductor plate electrode lead is required, (b) the monitoring current can produce an electric shock hazard, (c) the monitoring current can cause interference with patient monitoring apparatus, and (d) the monitor circuit requires additional circuit components connected to the plate electrode circuit increasing the difficulty of maintaining satisfactory electrical isolation.

An object of the present invention is to provide a way of making an electrodiathermy generator with an isolated output circuit, but without the hazard of diathermy burns from the plate circuit.

A further object of the invention is to eliminate the need for a plate electrode lead continuity monitor by providing an arrangement in which if the plate electrode is not connected or the lead is broken and an attempt is made to use the apparatus, the output voltage on the plate circuit will raise above the trigger level of the monitor, causing the generator to be switched off. To prevent the voltage exceeding the trigger level the plate must be connected to provide a lower capacitive impedance to earth.

According to the present invention there is provided an electrodiathermy apparatus comprising a generator circuit with a terminal which can be connected to an active electrode and a plate terminal which can be connected to a plate electrode; a voltage sensitive monitor circuit which is connected to a plate circuit of the generator, includes a rectifier having an output and is responsive to an increase in the voltage of the plate terminal with respect to earth beyond a predetermiend value; a trigger circuit connected to the rectifier output and operable when the

output voltage from the rectifier exceeds a predetermined value; a switch operable by the trigger circuit when the said output voltage exceeds the predetermined value to switch off the apparatus and/or to produce an alarm signal; and means between the plate electrode terminal and earth by which a fraction of the output of the generator circuit can be transferred to the monitor circuit.

The monitor is arranged to produce the control signal if the voltage on the diathermy plate with respect to earth rises above the predetermiend value.

This control signal is used to switch off a diathermy generator and also to give alarm indications. The voltage level at which the monitor is arranged to operate should be below that which a burn can be produced and this is typically below 100 volts.

The invention is illustrated in the accompanying drawing which is an electrical circuit diagram.

In the illustrated embodiment of the invention, an electro-diathermy apparatus has a monitor in the form of a voltage sensing circuit. This voltage sensing or monitor circuit is connected to an electrode, or plate, circuit of the diathermy apparatus, such electrode circuit being connected with an active electrode and a plate electrode through terminals 1, connected with a generator output coil 2 of the electrode circuit. The connection between the monitor circuit and the electrode circuit includes a capacitor 3, the value of which is sufficiently low that it does not appreciably increase the capacitance to the electrode circuit. The capacitor 3, which may be replaced by a resistor, a miniature transformer or an optically coupled isolator, is a means by which a small part of the generator output from the electrode circuit can be transferred to the monitor circuit. The voltage sensing circuit includes a half wave rectifier circuit including a diode 4, a capacitor 5, and a resistor 6. This half wave rectifier circuit produces a direct voltage at one input 7 of an operational amplifier 8. Another input 9 to the operational amplifier 8 is taken to a variable reference voltage obtained from a potentiometer 10. The operational amplifier 8 acts as a trigger circuit as its output changes rapidly from a maximum negative voltage to a maximum positive voltage, when the voltage across the resistor 6 of the half wave rectifier circuit exceeds a reference voltage which has been predetermined by the setting of the potentiometer 10.

The signal produced by the amplifier 10 is a control signal which is supplied to a relay switching means 11. When the signal is applied to the relay 11, the relay operates to break supply of power to a diathermy generator and also to illuminate an alarm lamp 12 or to actuate an audible alarm. It is desirable that the relay switching means 11 incorporates a latch to prevent the reconnection of the supply after the input signal has fallen to zero. The latch may be either electrical or mechanical and may be reset by either the operation of a control or automatically by other means in the circuit. The apparatus is provided with a re-set switch 13 which enables the supply of power to the generator to be restored or if desired, the re-set switch can be arranged to operate automatically on removal of the fault conditions.

Instead of a relay switching means 11, a semiconductor switch (either a transistor or thyristor) may be employed.

The amplifier 8 may in certain instances be unnecessary as the power level may be sufficient to operate the switch directly.

WHAT WE CLAIM IS:—

1. An electrodiathermy apparatus comprising a generator circuit with a terminal which can be connected to an active electrode and a plate terminal which can be connected to a plate electrode; a voltage sensitive monitor circuit which is connected to a plate circuit of the generator, includes a rectifier having an output and is responsive to an increase in the voltage of the plate terminal with respect to earth beyond a predetermined value; a trigger circuit connected to the rectifier output and operable when the output voltage from the rectifier exceeds a predetermined value; a switch operable by the trigger circuit when the said output voltage exceeds the predetermined value to switch off the apparatus and/or to produce an alarm signal; and means between the plate electrode terminal and earth by which a fraction of the output of the generator circuit can be transferred to the monitor circuit.

2. An apparatus as claimed in claim 1, wherein the trigger circuit is an amplifier, an input of the amplifier being connected with a potentiometer by which a variable reference voltage can be applied to the said input, another input of the output of the said amplifier being rapidly changeable from a maximum negative voltage to a maximum positive voltage when the said reference voltage has been exceeded thereby to produce a signal which actuates the switch.

3. An apparatus as claimed in either preceeding claim also having means to

prevent the switch being re-activated after it has been actuated by a signal from the trigger circuit.

4. An electrodiathermy apparatus substantially as described with reference to the accompanying drawings.

ELKINGTON & FIFE,
Chartered Patent Agents,
High Holborn House,
52/54, High Holborn,
London, WC1V 6SH.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1977
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1480736 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*